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THE JACK BEAN

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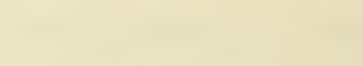
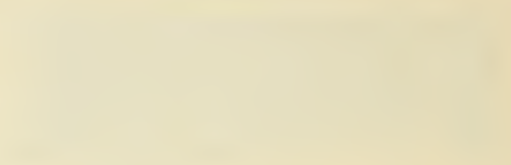


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THE JACK BEAN

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EXPLOITING THE JACK BEAN

The jack bean (*Canavalia ensiformis*) has several times been the subject of exploitation with much extravagant advertising. Each "booster" gives it a new designation, so that the plant now has a long list of names. The jack bean will grow well and mature wherever cotton can be grown; it produces heavy yields of seed and its large white beans are very attractive. Because of these facts, farmers who have seen the plant growing ask for definite information concerning its real value, but most persons learn of the bean under one name or another by reading advertising matter which highly magnifies the merits of the plant.

DESCRIPTION

The jack bean is a bushy, semierect annual plant, growing to a height of 2 to 4 feet. Under favorable conditions in the Tropics it is said sometimes to be more or less twining. This is not surprising, as even so bushy a plant as the soy bean will twine under certain conditions, such as constant shade. The stems are rather coarse and become woody toward the base. The rather thickish leaves have a decidedly bitter taste. The flowers are purple, the earliest borne near the base of the stem, so that many of the pods touch the ground. When mature the pods are hard and firm, 9 to 14 inches long, each containing 10 to 14 seeds. These are pure white, with a brown eye, or hilum. Ordinarily the roots are well tubercled. The plant will withstand much drought. There are at least three slightly different varieties, two of them—which grow 2 to 3 feet high—early enough

to mature in the cotton region, and a late variety, growing twice as tall, which will not mature except in southern Florida. In fully grown and matured plants of the smaller varieties the weight of the pods exceeds that of the herbage.

HISTORY

The jack bean is almost certainly a native of the West Indies and the adjacent mainland. In Jamaica, where it first became well known, it is called the horse bean or the overlook bean. The horse bean of Europe is a very different plant. In South Africa it has been called the sunshine bean. In the United States it has from time to time been known or exploited under various names, including Pearson bean, wonder bean, Wataka bean, Gotani bean, South American coffee bean, giant-pod stock bean, and flowering bean; Krauss cites also the name Chickasaw Lima bean. Owing to confusion with the similar species cultivated in Japan, China, and India it has also been called the sword bean and the knife bean, but those names properly belong to the Asiatic species, which is a different plant.

The first description of the plant was published in 1605 by Clusius. His figures of the pods and seeds received from Brazil are indistinguishable from the jack bean. Clusius, however, describes the seeds as brownish, but all subsequent authors state that the seeds are white, which is true of all that have been grown in this country. Sloane gave a good figure and description of the plant in 1707, under the name "horse bean," as he found it in Jamaica. He writes further that "they are eaten as other *Phaseoli* by some and counted good food, though their greatest use is to fatten hogs."

Fifty years later Browne wrote of the horse bean as follows:

This plant grows in many gardens in Jamaica, where it is cultivated chiefly out of curiosity. It seems to keep a main between the upright and the climbing species of *Phaseolus*, for the stem seldom rises above 3 or 4 feet, though it emits some slender delicate shoots that run much farther. The pods are commonly between 10 and 14 inches in length and generally contain 10 or 11 seeds, but the pulse is very seldom used, being generally thought more or less of a deleterious nature.

Macfayden, writing in the *Flora of Jamaica* in 1837, records as follows:

Sloane considers this species to be indigenous to the island and says the seeds were in his time used by some as food and given to fatten hogs. I do not find, however, on inquiry that any use is made at present of them, except that they are commonly planted by the Negroes along the margin of their provision grounds from a superstitious notion, probably of African origin, that the overlook fulfills the part of a watchman and, from some dreaded power ascribed to it, protects the provisions from plunder. Even the better informed adopt the practice, though they themselves may not place confidence in any particular

influence this humble plant can exercise, either in preventing theft or in punishing it when committed.

The superstition concerning the jack bean was doubtless brought by the Negroes from Africa, where even to the present day many tribes use the sword bean as a fetish; hence, that plant is often called the fetish bean. The same idea prevails in Panama even now.

At the present time the jack bean is found cultivated, occasionally at least, everywhere in the Tropics and Subtropics. It is nowhere a crop of staple importance.

BOTANY

Sloane in 1707 gave the first botanical description of the jack bean accompanied with a good figure. From these data Linnæus, in 1753, named the plant *Dolichos ensiformis*. Later, he mistakenly supposed the East Indian sword bean to be the same species. The two, however, are very clearly distinct species belonging to the genus *Canavalia*, or, as spelled by some authors, *Canavali*. The jack bean is *Canavalia ensiformis* and the sword bean *Canavalia gladiata*. Notwithstanding the excellent characters by which to distinguish the two species, they have been much confused in both the botanical and agricultural literature, so that it often is difficult to determine to which the published information really applies.

The sword bean, a vining plant, is native to the Old World, while the jack bean, ordinarily at least a bushy plant, is native to the New World. Both are now cultivated more or less throughout the Tropics and Subtropics.

The jack bean and the sword bean are easily distinguishable by their pods and seeds (fig. 1). The seeds furnish a character which is most reliable. In the jack bean the hilum, or scar, is only half as long as the seed, while in the sword bean it is nearly as long as the seed. The color of the seeds is always white in the jack bean, but in the sword bean it is most commonly red or pink, rarely brown, and in one Japanese variety white.

CULTURE

The jack bean is a plant of easy culture, but requires relatively a long season to mature. In the United States it continues to grow until killed by frost. Some of the pods will mature occasionally, at least, as far north as Washington, D. C., but in general the ordinary variety is adapted to about the same conditions as cotton. The plant is decidedly drought resistant, as shown by tests in Texas, Oklahoma, Hawaii, and New South Wales. Jack beans are best grown in cultivated rows about 3 feet wide, the plants 6 to 12 inches apart in the rows. In Hawaii the largest yields of green matter were secured from plantings in rows 2 to 3 feet wide and 3 to 6 inches apart in

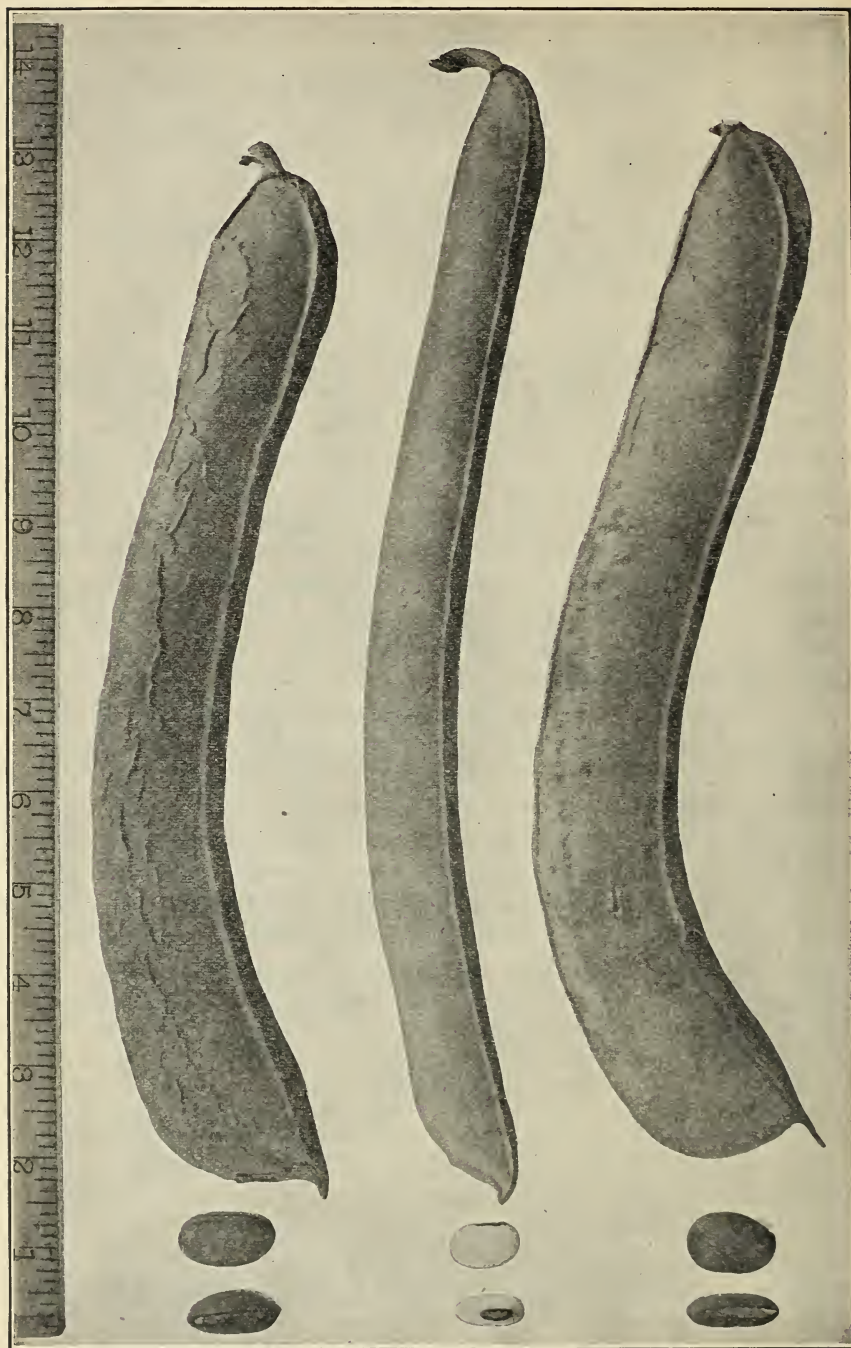


FIG. 1.—Pods and seeds of the jack bean and the sword bean: Central figure, pod of a jack bean (S. P. I. No. 21609) from Brazil. Right-hand figure, pod of a sword bean (S. P. I. No. 27676) from India. Left-hand figure, pod of a sword bean (S. P. I. No. 27704) from China.

the rows; for seed production, 6 to 10 inches apart in the rows. About 1 bushel of seed is required to plant an acre.

YIELDS

The jack bean has produced 16 to 20 tons of green herbage per acre in Hawaii; in Mauritius, 10 to 14 tons per acre when planted in every row of sugar cane and half this quantity when planted in every third row. No definite records of similar yields for the United States have been obtained. The heavy crops of seed are characteristic. The Mississippi Agricultural Experiment Station records yields of 30 to 50 bushels; the Texas station, 35 bushels; the North Carolina station, 40 bushels; and the Hawaii station, 20 bushels to the acre.

PESTS

No insects have been observed attacking the jack bean in the United States. In most countries the plant is reputed particularly free from insects, but such damage has been reported in Mauritius, Bourbon, Hawaii, and St. Kitts.

Root-knot is the most serious disease affecting the jack bean in the United States. In Hawaii a leaf blight is stated to occasion some damage.

CHEMICAL ANALYSES

The analyses of the various parts of the jack bean are sufficient in number and agreement to give a clear idea of their general composition.

TABLE I.—*Analyses of jack beans.*

Material.	Constituents (per cent).						Publication.
	Water.	Protein.	Fat.	Nitrogen-free extract.	Crude fiber.	Ash.	
Seeds.....	0	26.85	2.99	56.90	39.90	3.38	Miss. Exp. Sta. Ann. Rpt. 8, p. 43. 1895.
Do.....	11.06	23.82	3.52	50.79	8.05	2.77	Texas Exp. Sta. Bul. 170. 1914.
Do.....	13.00	25.62	2.32	47.94	7.90	3.22	Boname, Le Pois Sabre.
Do.....	15.50	27.60	3.20	45.20	5.40	3.10	Dept. Agr., Trinidad and Tobago. 1917.
Do.....	14.40	25.00	2.70	48.40	6.80	2.70	Bul. Imp. Inst. 1913.
Do.....	12.70	26.09	3.90	46.91	7.60	2.80	Bul. Imp. Inst. 1915.
Hulls.....	0	2.44	.52	48.51	43.89	4.64	Miss. Exp. Sta. Ann. Rpt. 8, p. 43. 1895.
Do.....	15.20	5.00	.64	15.47	57.91	5.78	Boname, Le Pois Sabre.
Whole pods with seeds..	0	17.76	3.06	65.08	19.31	3.79	Miss. Exp. Sta. Ann. Rpt. 8, p. 43. 1895.
Bean meal.....	11.48	23.75	2.65	50.37	8.75	3.00	Miss. Exp. Sta. Bul. 39, p. 159. 1896.
Green plant.....	76.81	5.21	.48	8.44	6.36	2.70	Hawaii Exp. Sta. Bul. 23, p. 31. 1911.
Do.....	80.92	2.88	.78	8.20	5.50	1.72	Boname, Le Pois Sabre.
Do.....	76.87	3.21	.55	10.86	7.36	1.15	Do.
Do.....	74.20	4.88	.70	12.29	5.83	2.10	Do.
Dry plant.....	0	15.10	4.09	42.96	28.83	9.02	Do.
Do.....	0	13.88	2.38	47.92	30.82	5.00	Do.
Do.....	0	18.93	2.71	47.60	22.61	8.15	Do.

ECONOMIC VALUE

On account of the confusion with the sword bean by numerous writers, there are many misstatements in the literature regarding the jack bean. The sword bean is a plant of ancient cultivation in India, China, Japan, the East Indies, the Orient generally, and apparently also among the Negroes of Africa. Both the green pods and the ripe seeds are used as human food. The seeds are commonly red or pink, but a brown-seeded variety occurs in India and a white-seeded sort in Japan. In India the brown seeds of a closely related wild species are known to be poisonous. All varieties of the sword bean are vining plants, none being bushy like the jack bean. From the above facts it is possible to tell in most cases which information really applies to each species in accounts where the two beans have been confused. However, in recent years much investigation has been given to the jack bean, so that there is no need to rely on older statements that may relate to the sword bean.

The actual or possible purposes for which the jack bean is or may be used include green manure, green feed, hay, ensilage, green pods or seeds for food, ripe seeds for food or feed, and the extraction of urease from the seeds. Each is discussed separately.

GREEN MANURE

The jack bean makes a large yield of herbage and so is suitable as a green-manure crop. The plant is subject, however, to root-knot, which often greatly reduces the growth. All tests thus far conducted in the Southern States show that both the cowpea and the velvet bean are preferable for green manure, and besides both furnish more palatable forage than does the jack bean.

In other countries, however, the jack bean has come into more or less extensive use as a cover and green-manure crop, especially in the Malay States, the Dutch East Indies, Mauritius, Dominica, Porto Rico, and the State of Sao Paulo, Brazil.

In Mauritius these beans are successfully grown between the rows of sugar cane. In Trinidad the jack bean is used as a cover crop in coconut and cacao plantations. In Porto Rico the plant has been widely tested as a green-manure crop in citrus orchards, coconut groves, and pineapple fields, with such favorable results that it is now used extensively. When grown with pineapples it is found to hinder their growth and production, but not so much as does the pigeon pea.

In the Dutch East Indies the jack bean has been found to be an excellent green-manure crop for tobacco. In New South Wales it was adjudged not so desirable as velvet beans or cowpeas. In the Malay States it is considered one of the best, and in Sao Paulo,

Brazil, as well as in Dominica, the best of green manures. For green manure it is best to plow the plants under when the pods are half grown, which under favorable conditions is about three months after planting.

GREEN FEED

Although the herbage of the jack bean is more or less bitter, animals can be accustomed to it and will then eat it freely. No particular efforts have been made in this country to educate animals to eat the herbage, but successful results are reported. The early feeding experiments with the green fodder in Hawaii gave unfavorable results, but as feeders gained in experience the fodder was found to be both palatable and nutritious for dairy cows and swine. It is important to use in the beginning only a small proportion of the jack bean with the accustomed ration, and to increase this quantity gradually. The Dowsett and Pond dairies, near Honolulu, have fed green jack beans and sorghum in equal proportions to dairy cows with excellent results, but recent correspondence discloses the fact that the jack-bean crop has not become a popular one with feeders in Hawaii.

The Oklahoma Agricultural Experiment Station reports that sheep eat the green herbage quite readily, and it apparently agrees with them, but on account of insufficient material no tests to determine its influence on weight have been made.

In Trinidad it is said to furnish a good quality of green forage.

HAY AND ENSILAGE

The coarse and rather fibrous stems of the jack bean have not commended it to experimenters as a hay plant, and there are no published records of its merits as such. It was, however, tried at the Mississippi Agricultural Experiment Station by Prof. S. M. Tracy, who states that the hay was refused by mules and finally was used as bedding.

For ensilage, however, the plant gives distinct promise and is worth testing for this purpose, as it is easily handled and produces a large tonnage. There is reason to believe that its palatability will be increased by ensiling.

THE YOUNG PODS AS A VEGETABLE

The young pods of the jack bean make a fair substitute for snap beans, but they toughen quickly when they become more than 4 or 5 inches long. The flavor is peculiar, but not objectionable. Boname considers them "very tender and palatable." They have a more pronounced flavor than those of the sword bean (*Canavalia gladiata*) and to the writer's taste are not so palatable. There seems no question, however, that the young pods are nutritious food.

THE SEEDS AS FOOD

Some suspicion has existed that the jack-bean seed contained deleterious or poisonous substances, but there seems no real basis for this opinion. No toxic substances have been found by any of several investigators. A related wild species in India (*Canavalia virosa*) is reputed, however, to be a narcotic poison.

The fully grown but still soft seeds of the jack bean are considered by Cheel in New South Wales much superior in flavor to green Lima beans. De Sornay regards them as good as kidney beans.

The ripe beans have a distinctive flavor, not unpleasing to most people. Prof. Tracy reports them of fair quality but coarse and that no ill effects were experienced by six people who ate them; Dodson and Stubbs say "not good for table use;" McCarthy considers them "insipid and poor." Sloane long ago recorded the fact that they were eaten by some people, and this is said yet to be the case in Trinidad. The Mexicans in Texas eat the jack bean freely.

On the whole, the evidence indicates that mature jack beans are fit for food but not as desirable as other beans.

THE ROASTED SEEDS AS A COFFEE SUBSTITUTE

The roasted seeds of many legumes have long been used to make a coffeelike drink. Such legumes include practically all the cultivated species with large seeds, besides many wild species. The jack bean makes a fair substitute for coffee and has often been so used. It is purely a matter of individual taste whether such a beverage is satisfying. There is no reason to believe that the jack bean has for this purpose any particular virtue as compared with other beans.

THE SEEDS AS FEED

The meal obtained by grinding dry seeds of the jack bean has been tested for feed at the Mississippi Agricultural Experiment Station, but no other comparable trials are reported. It was extensively tested at that station during the years 1890 to 1895. Under field conditions yields of 30 to 50 bushels per acre were obtained. On account of these heavy yields attempts were made to utilize the beans as stock feed. They were found to be very unpalatable to all kinds of live stock, even when ground into meal or when cooked. Mixed with cottonseed meal the bean meal was eaten by beef cattle, but the feeding experiment gave very poor results compared with other feeds. The following is quoted from the station report:

Three of the lots of beef cattle fed with bean meal made a smaller gain than did any of the lots receiving cottonseed meal, and the best of the meal lots, No. 4a, gained only 3.4 pounds more than did the poorest of the lots receiving cottonseed meal. It should be noted that the lots receiving bean meal were also fed cottonseed meal amounting to about one-third of the grain ration, and a

large part of their small gain should doubtless be credited to the cottonseed meal and not to the bean meal.

The complete failure to secure profitable results from the use of the bean meal was a surprise and disappointment. Various methods of feeding were tried, both coarse and fine meal being used, and during a portion of the time the meal was cooked until it was thoroughly softened. At first very few of the steers would eat any of the meal, but were finally induced to do so by mixing it with salt and cottonseed meal, so that when the trial feedings began all ate it fairly well, though not with much apparent relish. The meal which was eaten appeared to be very indigestible for the animals, and the same was found to be the case when it was fed to milch cows, as will be shown in another bulletin, soon to be published.

If the different feeds are considered with reference to only single ingredients of the several rations, the average gains per steer were as follows:

	Pounds.		Pounds.
Shredded corn and silage--	35.1	Red-clover hay -----	71.7
Crab-grass hay-----	51.5	Cottonseed meal-----	62.0
Pea-vine hay-----	60.2	Bean meal -----	28.4

The bulletin referred to as "soon to be published" was never issued. Prof. E. R. Lloyd, however, kindly supplied the general results in the following statement:

The dairy cattle ate them so sparingly that the results were never published, but were about the same as from the steer feeding. We tried them with hogs, whole and ground, raw and cooked, but were unable to get the hogs to eat a sufficient quantity to be of any economic value. Mixed with shorts and corn meal, when the ration was only one-fourth bean meal, the hogs refused to eat it.

UREASE

Various studies have been made to determine the organic compounds contained in the jack bean. Only one of the substances is of commercial value, namely, urease, which is utilized in medicine. Commercial supplies of this substance were formerly obtained from the soy bean, but Mateer and Marshall found in 1916 that the jack bean contains about fifteen times as much urease as the soy bean. The demand for urease is, however, limited, and the world's annual requirements of this substance would not exceed that secured from 500 bushels of jack beans.

CONCLUSIONS

So far as the United States is concerned, the rather large amount of scattered data do not indicate that the jack bean is ever likely to become an important crop. Its one most striking characteristic is its high percentage of urease, but a few hundred bushels of seed at most will supply the world's demand for this substance.

As a green-manure crop the jack bean does not compare favorably with velvet beans or cowpeas, while for green feed both these crops, as well as soy beans, are superior. For ensilage it may be found useful.

The large yields of pods and seed make the jack bean peculiarly interesting. Both the pods and seeds are fair vegetables, but not so good as other beans. The ripe seeds, no matter how prepared, are not eaten eagerly by live stock, and certainly the crop in this particular can scarcely be expected to compete with the velvet bean.

If, under American conditions, the jack bean possesses any possibilities for extensive culture superior to such crops as cowpeas, soy beans, and velvet beans, the investigations thus far have failed to reveal them.

Any farmer interested is justified in trying the plant only in a small experimental plat. Under peculiar conditions it may possess local value enough to justify cultivation.

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